Valve and Method For Repairing a Valve Under Pressure

BACKGROUND OF THE INVENTION

1. Technical Field

[01.00] This invention relates generally to valves for lines carrying water, sewage, natural gas, or other fluid, and more particularly to a valve and method for repairing a valve under pressure without first shutting down the line.

2. Description of Related Art

[02.00] A typical valve may be manufactured from any of various materials, including ductile iron, cast iron, stainless steel, brass, plastics, and/or any of various exotic materials needed in special applications. The size can range from1/4-inch diameter or less to a 144-inch diameter or more. The valve may include a one-piece valve body with a hollow interior that extends between first and second ends of the valve body. The first and second ends are threaded, flanged, grooved, or otherwise configured so that a user can readily connect each end to a respective one of separate first and second pipeline sections, either directly or via intermediate fittings. In that regard, the term "pipeline" includes any type, size, and composition of fluid-carrying conduit, and the hollow valve body interior couples the first and second pipeline sections in fluid communications.

[03.00] What is sometimes called a valve-stopping mechanism is mounted in the valve body. More specifically, part of the valve body defines an opening in the valve body that provides access to the hollow valve body interior. The valve-stopping mechanism is removably mounted within that opening in fluid-tight engagement of the valve body. There, it functions as means for enabling the user to selectively stop and unstop fluid communications between the first and second pipeline sections (i.e., between the first and second ends of the valve body). The opening in the valve body will subsequently be referred to as an "access opening," and the portion of the valve body that defines the access opening will subsequently be referred to as an "opening-defining portion" of the valve body. The valve-stopping mechanism is sometimes called a user-operated, isolator mechanism or valving element. Known valve-stopping mechanisms include metal gate, rubber coated gate, butterfly, plug, ball, and check valve stopping mechanisms, each having its own special features and advantages. In addition, the hollow interior of the valve body may include mating surfaces cast into the body or attached to the body by known valve technology to create a seating surface for the valve-stopping mechanism. Attached materials may include brass, steel, stainless steel, plastics, and other known materials.

[04.00] Regardless of the particular style of the valve-stopping mechanism, a valve is prone to becoming corroded, obstructed by mineral and/or chemical deposits or debris, or otherwise damaged to the point that it requires servicing in order to clean or resurface the hollow valve body interior and/or to clean, resurface, or replace the valve-stopping mechanism. The line may have to be shut down so that the valve is not

under pressure. The valve is then serviced and afterwards the line is turned back on. However, the consequences of shutting down the line may be significant. For example, shutting down a municipal water main in order to service a branch line to a subdivision results in many inconvenienced and potentially monetarily damaged water customers.

[05.00] Undertaking to shut down hospital systems, manufacturing plants, hotels, or nuclear facilities is also fraught with adverse consequences, including the cost of a plant shut down or the lack of fire protection during the shut down. The problem exists with gas valves, air valves, water valves, sewage valves, steam valves, any of numerous chemical valves, and other fluid valves for above ground and below ground pipe, including sub-sea systems. Thus, a need exists for a valve and repair method such that the valve can be installed when the pipe is installed and then serviced under pressure (i.e., with the valve containing fluid under pressure) without shutting down the line.

SUMMARY OF THE INVENTION

[06.00] This invention addresses the concerns outlined above by providing a valve having a valve body with an opening-defining portion that includes connection-facilitating means for facilitating the fluid-tight removable connection of what is referred to herein as a separate "isolation valve assembly" onto the opening-defining portion of the valve body. The connection-facilitating means facilitates connection of the isolation valve assembly in a position over the access opening that enables a user to

remove the valve-stopping mechanism through the isolation valve assembly. A valve-servicing assembly that includes such an isolation valve assembly and an attached pressure-chamber-defining structure is used for valve-servicing purposes so that the valve-stopping mechanism can be removed from the access opening through the isolation valve assembly and into the chamber-defining structure while the valve is under pressure (i.e., the valve contains fluid under pressure). The chamber-defining structure may be similar in many respects to known equipment, and servicing or replacement of the valve-stopping mechanism and valve body cleaning can be conducted using the pressure chamber while the valve contains fluid under pressure. Thus, a shut down with all the potential adverse consequences is avoided.

[07.00] To paraphrase some of the more precise language appearing in the claims and further introduce the nomenclature used, a valve constructed according to the invention includes a valve body and a valve-stopping mechanism. The valve body has first and second ends and it defines a hollow valve body interior extending between the first and second ends that couples the first and second ends in fluid communications. The valve body includes an opening-defining portion that defines an access opening in the valve body. The valve-stopping mechanism is removably mounted within the access opening where it functions as means for enabling a user to selectively stop and unstop fluid communications between the first and second ends of the valve body.

[08.00] According to a major aspect of the invention, connection-facilitating means are provided on the opening-defining

portion of the valve body for facilitating the fluid-tight removable connection of a separate isolation valve assembly to the opening-defining portion of the valve body. The connection-facilitating means facilitate connection of the isolation valve assembly in a position over the access opening that enables the user to remove the valve-stopping mechanism from the access opening through the isolation valve assembly. The connection-facilitating means facilitate such a connection without obstructing removal of the valve-stopping mechanism from the access opening. The connection-facilitating means may include one or more of a flange, an exterior thread, annular grooves, annular rings, or a cam lock arrangement. Other forms of connection-facilitating means may be employed within the scope of the broader claims. Whatever the form, the connection-facilitating means are part of the valve so that they are ready to use when needed.

[09.00] In line with the foregoing, a method for repairing such a valve under pressure includes the step of providing a valve-servicing assembly of which the isolation valve assembly is a part. The isolation valve assembly has first and second ends and a size large enough to enable a user to remove the valve-stopping mechanism from the access opening through the isolation valve assembly. The valve-servicing assembly includes a chamber-defining structure connected to the second end of the isolation valve assembly that defines a pressure chamber (i.e., a fluid-tight chamber) in which the valve-stopping mechanism fits.

[10.00] The method proceeds by connecting the first end of the isolation valve assembly to the opening-defining portion of the valve body in a

position over the access opening. Next, the valve-stopping mechanism is withdrawn from the access opening, through the isolation valve assembly, into the fluid-tight chamber. Then, the isolation valve assembly is closed.

[11.00] In the case of repairing the valve-stopping mechanism, the method includes removing the valve-stopping mechanism from the fluid-tight chamber and servicing the valve-stopping mechanism, placing the valve-stopping mechanism back into the fluid-tight chamber, opening the isolation valve assembly, advancing the valve-stopping mechanism from the fluid-tight chamber through the isolation valve assembly back into the access opening. In the case of replacement, the replacement valve-stopping mechanism is placed into the chamber and advanced into the access opening. In either case, the valve-servicing assembly may be removed from, or left connected to, the opening-defining portion of the valve body.

[12.00] Thus, the invention significantly facilitates the repair under pressure of a valve so that the line does not have to be shut down. Preferably, the valve is installed when the pipeline is installed. When the valve requires repair, the valve-servicing assembly is connected to the opening-defining portion of the valve body and repair is undertaken under pressure. If it is desired, just a valve body with a plugged or capped access opening may be installed without the valve-stopping mechanism instead of installing the entire valve. In that case, a valve-stopping mechanism can be added under pressure if it is ever needed. The following illustrative drawings and detailed description make the foregoing

and other objects, features, and advantages of the invention more apparent.

BRIEF DESCRIPTION OF THE DRAWINGS

[13.00] FIG. **1** of the drawings is an isometric view of a valve constructed according to the invention;

[14.00] FIG. **2** is an elevation view of the valve, with portions in cross section as viewed in a plane containing a line **2-2** and the rotational axis in FIG. **1**;

[15.00] FIG. **3** is an elevation view of the valve, with portions in cross section as viewed in a plane containing a line **3-3** and the rotational axis in FIG. **1**;

[16.00] FIG. **4** is a plan view of the valve, with portions in cross section as viewed in a plane perpendicular to the rotational axis that contains a line **4-4** in FIG. **3**;

[17.00] FIG. **5** is a plan view of the valve, with portions in cross section as viewed in a plane perpendicular to the rotational axis that contains a line **5-5** in FIG. **3**;

[18.00] FIGS. **6a** through **6g** are diagrammatic representations of various steps of the valve repair methodology of the invention;

[19.00] FIG. **7** is an isometric view of a second embodiment of a valve constructed according to the invention;

[20.00] FIG. **8** is an enlarged cross sectional elevation view of just the valve body of the second embodiment as viewed in a plane containing a line **8-8** and the rotational axis in FIG. **7**;

[21.00] FIG. **9** is an enlarged elevation view similar to FIG. **8**, but with the valve-stopping mechanism added;

[22.00] FIG. **10** is another elevation view of the second embodiment with a valve-servicing assembly illustrated diagrammatically connected over the access opening;

[23.00] FIG. **11** is an elevation view similar to FIG. **9** of a portion of a third embodiment constructed according to the invention showing various means for facilitating the connection of the valve-servicing assembly; and

[24.00] FIG. **12** is an elevation view similar to FIG. **9** of a portion of a fourth embodiment of a valve constructed according to the invention showing a cam lock arrangement for facilitating connection of the valve-servicing assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[25.00] FIGS. **1-5** of the drawings show various aspects of a valve **10** constructed according to the invention. Generally, the valve **10** includes first and second subassemblies referred to in this description as a valve body **11** and a valve-stopping mechanism **12** (FIGS. **1-3**). The valve body **11** is preferably a one-piece structure that extends along a valve body axis **13** between first and second ends **14** and **15** of the valve body **11** (FIGS **1-5**), and it defines a hollow valve body interior **16** (FIG. **2**) that couples the first and second ends **14** and **15** in fluid communications. The valve body **11** is composed of ductile iron, steel, composite material, or other suitable composition and the ends are connected to first and second pipeline sections **17** and **18**. The valve body **11** may be one-piece because it is not installed over the pipeline at some later date as a retrofit. It is installed with the pipeline sections **17** and **18**.

[26.00] The OD of the illustrated six-inch pipeline sections **17** and **18** might typically measure about 6.5 inches to 7.75 inches, but the invention works on any of various sized pipeline with 1/4-inch or less diameter up to 114-inch or larger diameter. A valve body constructed according to the invention is sized according to the pipe OD with which it will be used. The valve body **11** of the illustrated valve **10** fits the six-inch OD of the pipe **18**, with the valve body **11** and the first and second pipeline sections **17** and **18** disposed coaxially relative to the valve body axis **13**. Each of the first and second glands **19** and **20** (FIGS. **1** and **2**) bolts onto a respective one of the first and second ends **14** and **15** of the valve

body **11** where they bear against first and second split rubber seals **21** and **22** (FIG. **2**) in order to seal the first and second ends **14** and **15** of the valve body **11** on the first and second pipeline sections **17** and **18** in fluid-tight connections. The glands and rubber seals may take the form of known types of components.

[27.00] The valve body **11** includes an opening-defining portion **23** that defines an access opening **24** in the valve body **11** (FIGS. **2** and **5**). A portion of the valve-stopping mechanism **12** is broken away in FIG. **5** for illustrative reasons to expose the access opening **24**. The valve-stopping mechanism **12** is removably mounted in the access opening **24** where it functions as means for enabling a user to selectively stop and unstop fluid communications between the first and second ends **14** and **15** of the valve body **11**. The valve-stopping mechanism **12** includes a flange-mating portion **12A** that is shaped and dimensioned to fit into the access opening **24** in a fluid-tight fit. The flange-mating portion **12A** may include an O-ring seal. Set screws extending through a flange **23A** on the opening-defining portion **23** of the valve body **11** function as means for holding or vertically restraining the valve-stopping mechanism **12** within the access opening **24**. For illustrative reasons, just one set screw **12B** is identified in FIG. **2** and just one other set screw **12C** is identified in FIG. **3**. A retainer ring **23B** bolts onto the flange **23A** to help secure the valve-stopping mechanism **12** in place.

[28.00] The illustrated valve-stopping mechanism **12** includes a bonnet **25**, a gate **26**, and a gate-advancing mechanism **27** (e.g., a

rotatable threaded stem and nut combination). The gate-advancing mechanism **27** functions as means for enabling a user to advance the gate **26** between open and closed positions of the gate **26**. The gate-advancing mechanism **27** advances and withdraws the gate **26** in response to the user turning a square head portion **28** of the gate-advancing mechanism **27** (e.g., with a wrench or other suitable head-engaging tool). As the square head portion **28** rotates on a rotational axis **29** that is perpendicular to the valve body axis **13**, the gate **26** advances or withdraws along the rotational axis **29**.

[29.00] In the closed position of the gate **26** illustrated in FIGS. **2-5**, the gate is disposed intermediate the first and second ends **14** and **15** of the valve body **11**, with the gate **26** being in fluid-tight engagement of the valve body **11** (or conventional types of seating arrangements attached to the valve body **11**) and preferably in fluid-tight engagement of the flange-mating portion **12A** of the valve-stopping mechanism **12**. So disposed, the gate **26** blocks (stops) the flow of fluid through the valve body **11** between the first and second ends **14** and **15** and between the first and second pipeline sections **17** and **18**. In the open position of the gate **26**, the gate **26** does not block the flow of fluid through the valve body **11** because the gate **26** is withdrawn from the closed position as depicted by the phantom line **26A** in FIG. **3**.

[30.00] The illustrated gate **26** is fabricated from ductile iron in the desired shape and then a rubber coating is bonded on using known transfer mold compression mold, or other techniques. The rubber coating

helps effect the desired fluid-tight seal between the gate **26** and the valve body **11** and, if desired, between the gate **26** and the bonnet **25** of the valve-stopping mechanism **12** if the need arises. As an idea of size, the illustrated gate **26** (for use with six-inch pipe) measures about 9.0 inches wide.

[31.00] According to a major aspect of the invention, the valve **10** includes means on the opening-defining portion **23** of the valve body **11** for facilitating the fluid-tight removable connection of a separate second valve assembly (referred to herein as an isolation valve assembly) to the opening-defining portion **23** of the valve body **11**. Those means are referred to herein as connection-facilitating means and they facilitate connection of the isolation valve assembly subsequently described over the access opening **24** in a position that enables the user to remove the valve-stopping mechanism **25** from the access opening **24** through the isolation valve assembly. The connection-facilitating means facilitate such a connection without obstructing removal of the valve-stopping mechanism from the access opening **24**. The flange **23A** serves the connection-facilitating function for the valve **10** in addition to supporting the retainer ring **23B**. In other words, the opening-defining portion **23** of the valve body **11** includes a flange **23A** that functions as means for facilitating the connection of the isolation valve assembly to the opening-defining portion **23** of the valve body **11** by bolting. The user removes the retainer ring **23B** from the flange **23A** (unbolts it) and then bolts the isolation valve assembly to the flange **23A**.

[32.00] The use of a valve-servicing assembly **30** that includes an isolation valve assembly **31** and a chamber-defining structure **32** is illustrated in the diagrammatic views of FIGS. **6a-6b**. First consider FIG. **6a**. It shows the valve **10** installed between the first and second pipeline sections **17** and **18**, and it is assumed here that the valve **10** is in need of servicing. In servicing the valve **10** according to the invention, the valve-servicing assembly **30** is connected to the flange **23A** on the opening-defining portion **23** of the valve body **11**. That is done for the valve **10** by bolting the isolation valve assembly **31** directly to the flange **23A**. However, the term "connection" herein also includes an indirect connection via one or more intermediate fittings or other components (e.g., a size adapter fitting).

[33.00] The arrows in FIG. **6b** show the direction a user moves the valve-servicing assembly **30** relative to the valve **10** (along the rotational axis **29**) to place it in position over the access opening **24** (described earlier with reference to FIGS. **2** and **5**) in the opening-defining portion **23** of the valve body **11** . That is done with the isolation valve assembly **31** open. illustrated isolation valve assembly **31** is a gate valve that includes first and second ends **31A** and **31B** (identified in FIG. **6b**) and a gate **31C** that is shown in FIG. **6b** in an open position. However, any of various known types of valves can be used as an isolation valve as long as the valve-stopping mechanism can pass through it. The gate **31C** can be closed to seal off the access opening **24** when desired, and opened to expose the access opening **24**.

[34.00] The chamber-defining structure **32** connects to the second end **31B** of the isolation valve assembly **31** to form the valve-servicing assembly **30**. With the valve-servicing assembly **30** connected in fluid-tight engagement of the flange **23A** by connection of the first end **31A** of the isolation valve assembly **31** to the flange **23A**, and with the gate **31C** in an open position, the valve-stopping mechanism **12** is withdrawn from the access opening **24**. It is withdrawn through the open isolation valve assembly **31** into a pressure chamber **33** (identified in FIG. **6b**) within the chamber-defining structure **32**. Withdrawal of the valve-stopping mechanism **12** into the chamber-defining structure **32** is depicted in FIG. **6c**. It is accomplished using a user-operated, moveable component **34** that is part of the valve-servicing assembly **30** The illustrated moveable component **34** is constructed according to known techniques to grip, turn, and withdraw the valve-stopping mechanism **12** under user control.

[35.00] Next, the user closes the isolation valve assembly **31** by moving the gate **31C** to the closed position as depicted in FIG. **6d**. Doing so isolates the chamber **33** in the chamber-defining structure **32** from the access opening **24** in the valve body **11**. With the access opening **24** closed in that manner (i.e., isolated), the user removes the valve-stopping mechanism **12** from the chamber-defining structure **32** for repair or replacement. Before placing a repaired or replacement valve-stopping mechanism back into the chamber-defining structure **32**, the user can clean, or resurface the hollow valve body interior **16** (described earlier with reference to FIGS. **2** and **4**) through the isolation valve assembly **31**

using the moveable component **34** in the chamber-defining structure **32** of the valve servicing assembly **30**.

[36.00] After that, the user places a repaired or replacement valve-stopping mechanism **12A** into the chamber-defining structure **32** and opens the isolation valve assembly **31** as depicted in Fig. **6e**. The valve-stopping mechanism **12A** is then mounted in the access opening **24** defined by the opening-defining portion **23** of the valve body **11** and the valve-servicing assembly **30** is removed as depicted in FIG. **6f**. That results in the serviced valve **10** depicted in FIG. **6g** without shutting down the line.

[37.00] With further regard to the valve-servicing assembly **30**, the chamber-defining structure **32** may take the form of a modified "completion tool." A completion tool is a known existing tool used for inserting products into pressurized pipeline systems that has been converted with well known methods to include the moveable component **34** that enables the user to grip and remove the valve-stopping mechanism **12** from the access opening **24**, to grip and manipulate components for cleaning and resurfacing of the hollow valve body interior **16** of the valve body **11**, and to grip and install the valve-stopping mechanism **12A** into the access opening **24**. It enables the user to do those things under pressurized conditions and it is familiar to one of ordinary skill in the art.

[38.00] To summarize the above-described methodology, the method is one for repairing under pressure a valve having a valve body, an

opening-defining portion of the valve body that defines an access opening, a valve-stopping mechanism removably mounted within the access opening, and means on the opening-defining portion of the valve body for facilitating the connection of a separate isolation valve assembly to the opening-defining portion. The method includes the step of providing a valve-servicing assembly of which the isolation valve assembly is a part such that the isolation valve assembly has first and second ends and a size large enough to enable a user to remove the valve-stopping mechanism from the access opening through the isolation valve assembly, the valve-servicing assembly including a chamber-defining structure connected to the second end of the isolation valve assembly that defines a chamber in which the valve-stopping mechanism fits. The method proceeds by connecting the first end of the isolation valve assembly to the opening-defining portion of the valve body in a position over the access opening, withdrawing the valve-stopping mechanism from the access opening, through the isolation valve assembly, into the fluid-tight chamber, and closing the isolation valve assembly.

[39.00] In the case of repair, the method also includes the steps of removing the valve-stopping mechanism from the fluid-tight chamber and servicing the valve-stopping mechanism. The method then proceeds by installing a completion tool within the chamber-defining structure, opening the isolation valve, advancing the completion tool into the access opening, and performing cleaning and/or resurfacing of the hollow valve body and the seating area for the valve-stopping mechanism. After that, the method proceeds by retracting the completion tool, closing the isolation valve, placing the valve-stopping mechanism back into the fluid-tight chamber,

opening the isolation valve assembly, and advancing the valve-stopping mechanism from the fluid-tight chamber through the isolation valve assembly back into the access opening. In the case of replacement, the method includes the steps of removing the valve-stopping mechanism from the fluid-tight chamber, placing a replacement valve-stopping mechanism into the fluid-tight chamber, cleaning and/or resurfacing as may be needed, opening the isolation valve assembly, and advancing the replacement valve-stopping mechanism from the fluid-tight chamber through the isolation valve assembly into the access opening. In either case, the user may disconnect the first end of the isolation valve assembly from the opening-defining portion of the valve body.

[40.00] Based upon the foregoing and subsequent descriptions, one of ordinary skill in the art can readily practice the invention and incorporate various changes without departing from the scope of the claims. The valve body, for example, may be manufactured from any of various materials, including ductile iron, cast iron, stainless steel, brass, plastics, and any of various exotic materials needed in special applications. The size can range from1/4-inch diameter or less to a 144-inch diameter or more. In addition, the first and second ends of the valve body configured so that a user can readily connect each end to a respective one of separate first and second pipeline sections, either directly or via intermediate fittings using any of various known connection means, including flanged, mechanical joint, pipe threads, solder, welded ends, compression and push-in fittings, and grooved locking methods including cam locks or bayonet-type locks similar to those used in kitchen blenders, camera lenses, or bolt action rifles. The valve-stopping mechanism may

take any of various known forms, including metal gate, rubber coated gate, butterfly, plug, ball, and check valve stopping mechanisms, and the connection-facilitating means may take any of various forms including a flange, a threaded portion, grooved locking methods, machine screw connections, and any of many other known locking means.

[41.00] FIGS. **7**, **8**, **9**, and **10** illustrate various aspects of a second valve embodiment (a valve **100**) that incorporates some of the above-mentioned alternatives. The valve **100** is similar is some general respects to the valve **10** and so only differences will be described in further detail. For convenience, numerals designating parts of the valve **100** are increased by one hundred over numerals designating similar, corresponding, or related parts of the valve **10**.

[42.00] The valve **100** includes a valve body **111** and a valve-stopping mechanism **112** (FIG. **7**). They are composed of brass. The valve body **111** has first and second ends **114** and **115** and a hollow interior **116** (FIGS. **8-10**) that extends along an axis **113** between the first and second ends **114** and **115**. The valve **100** is illustrated with the first and second ends **114** and **115** connected by interior pipe threads **141** and **142** to first and second pipeline sections **117** and **118**.

[43.00] The valve body **111** includes an opening-defining portion **123** that defines an access opening **124** (FIGS. **8-10**). The valve-stopping mechanism **112** is mounted removably in the access opening **124** by means of an interior thread **143** (FIGS. **8-10**) on the opening-defining

portion **123** that functions as means for holding or vertically restraining the valve-stopping mechanism **112** within the access opening **124**. The user rotates a wheel **144** (FIGS. **7-9**) that is held on the valve stopping-mechanism **112** by a nut **145** (FIG. 7) in order to advance and withdraw the valve stopping-mechanism **112** along a rotational axis **129** as depicted by the arrows in FIG. **9**. Doing so stops and unstops fluid flow through the valve body **111**.

[44.00] The opening-defining portion **123** of the valve body **111** includes connection-facilitating means in the form of an exterior thread **146** (FIGS. **7-10**). The thread **146** functions as means on the opening-defining portion **123** of the valve body **111** for facilitating the fluid-tight removable connection of a separate isolation valve assembly **131** (FIG. **10**) to the opening-defining portion **123** of the valve body **111** in a position over the access opening **124** that enables the user to remove the valve-stopping mechanism **112** from the access opening **124** through the isolation valve assembly **131**. The isolation valve assembly **131** is part of a valve-servicing assembly **130** that includes a chamber-defining structure **132** (FIG. **10**). The isolation valve assembly **131** has a first end **131A** that connects to the opening-defining portion **123** using the exterior thread **146**, and a second end **131B** to which the chamber-defining structure **132** is connected.

[45.00] FIG. **11** illustrates a third embodiment with different connection-facilitating means. It is designated as a valve **200** with a valve-stopping mechanism **212**. The valve **200** is similar in many respects

to the valve **100** and so only differences will be described in further detail. For convenience, numerals designating parts of the valve **200** are increased by one hundred over numerals designating similar, corresponding, or related parts of the valve **100**.

[46.00] A first connection-facilitating arrangement illustrated by the valve **200** is an annular groove **250** in an opening-defining portion **223** of the valve. The valve-servicing assembly **230** includes an annular groove **251** also. A sealing member **252** (e.g., elastomeric ring) is disposed between the grooves **250** and **251** to effect a fluid-tight seal. The sealing member **252** has been omitted on one side of the opening-defining portion **223** in FIG. **11** for illustrative reasons in order to expose the grooves **250** and **251** for identification. A second connection-facilitating arrangement by the valve **200** is an annular groove **253** in the opening-defining portion **223** that mates with a radially inwardly protruding annular ring **254** of the valve-servicing assembly **230**. A portion of the valve-servicing assembly **230** has been broken away in FIG. **11** for illustrative reasons in order to expose the groove **253** for identification. A third connection-facilitating arrangement illustrated by the valve **200** is a radially outwardly protruding annular ring **255** that mates with an annular groove **256** in the valve-servicing assembly **230**. A portion of the opening-defining portion **223** in has been broken away for illustrative reasons in order to expose the groove **256** for identification. A compression member **257** applies force radially inwardly to the valve-servicing assembly **230** to help effect a fluid-tight seal.

[47.00] FIG. **12** illustrates a fourth embodiment with some more different connection-facilitating means. It is designated as a valve **300** with a valve-stopping mechanism **312**. The valve **300** is similar in many respects to the valve **200** and so only differences will be described in further detail. For convenience, numerals designating parts of the valve **300** are increased by one hundred over numerals designating similar, corresponding, or related parts of the valve **300**.

[48.00] A first connection-facilitating arrangement illustrated by the valve **300** is a segmented annular groove **360** in an opening-defining portion **323** of the valve **300** that mates with a segmented annular ring **361** in the valve-servicing assembly **330** to form a cam lock. A second connection-facilitating arrangement illustrated by the valve **300** is a segmented annular ring **362** in the opening-defining portion **323** of the valve **300** that mates with a segmented annular groove **363** in the valve-servicing assembly **330** to form a cam lock. A third connection-facilitating arrangement illustrated by the valve **300** is a machine screw **364** that extends through a hole in the valve-servicing assembly **330** (a hole similar to a hole **365** that is identified in FIG. **12** on the opposite side of the valve-servicing assembly **330**) into an interiorly threaded hole in the opening-defining portion **323** that is similar to a threaded hole **366** on the opposite side of the opening-defining portion **323**.

[49.00] Thus, the valve and methodology of this invention enables the user to remove the valve-stopping mechanism from the opening-defining

portion of the valve being serviced through a separate isolation valve into a pressure chamber for servicing or replacement while the valve being serviced contains fluid under pressure. The valve being serviced includes connection-facilitating means that facilitates connection of the isolation valve so that servicing can proceed without shutting down the line. Although exemplary embodiments have been shown and described, one of ordinary skill in the art may make many changes, modifications, and substitutions without necessarily departing from the spirit and scope of the invention.

[50.00] What is claimed is: